

## Day 8: Text Analysis

ME414: Introduction to Data Science and Big Data Analytics

LSE Methods Summer Programme

23 August 2017

# Day 8 Outline

## Key features of QTA

- Quantitative text analysis workflow

- Key basic concepts

## Documents and features

- Strategies for selecting documents

- Defining features

- Parts of speech

- Filtering features

- “stopwords”

## Descriptive text analysis

- Key words in context

- Descriptive text statistics

- Lexical diversity

## Content analysis

## Dictionary analysis

## **Key features of Quantitative Text Analysis**

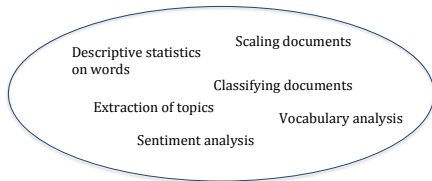
# Basic QTA Process: Texts → Feature matrix → Analysis

When I presented the supplementary budget to this House last April, I said we could work our way through this period of severe economic distress. Today, I can report that notwithstanding the difficulties of the past eight months, we are now on the road to economic recovery.

In this next phase of the Government's plan we must stabilise the deficit in a fair way, safeguard those worst hit by the recession, and stimulate crucial sectors of our economy to sustain and create jobs. The worst is over.

This Government has the moral authority and the well-grounded optimism rather than the cynicism of the Opposition. It has the imagination to create the new jobs in energy, agriculture, transport and construction that this green budget will

docs	words												
	made	because	had	into	get	some	through	next	where	many	irish		
t06_kenny_fg	12	11	5	4	8	4	3	4	5	7	10		
t05_cowen_ff	9	4	8	5	5	5	14	13	4	9	8		
t14_o'caolain_sf	3	3	3	4	7	3	7	2	3	5	6		
t01_lenihan_ff	12	1	5	4	2	11	9	16	14	6	9		
t11_gormley_green	0	0	0	3	0	2	0	3	1	1	2		
t04_morgan_sf	11	8	7	15	8	19	6	5	3	6	6		
t12_ryan_green	2	2	3	7	0	3	0	1	6	0	0		
t10_quinn_lab	1	4	4	2	8	4	1	0	1	2	0		
t07_odonnell_fg	5	4	2	1	5	0	1	1	0	3	0		
t09_higgins_lab	2	2	5	4	0	1	0	0	2	0	0		
t03_burton_lab	4	8	12	10	5	5	4	5	8	15	8		
t13_cuffe_green	1	2	0	0	11	0	16	3	0	3	1		
t08_gilmore_lab	4	8	7	4	3	6	4	5	1	2	11		
t02_bruton_fg	1	10	6	4	4	3	0	6	16	5	3		



# What role for “qualitative” analysis in QTA?

- ▶ Ultimately all reading of texts is qualitative, even when we count elements of the text or convert them into numbers
- ▶ QTA may involve human judgment in the construction of the feature-document matrix
- ▶ But quantitative text analysis differs from more qualitative approaches in that it:
  - ▶ Involves large-scale analysis of many texts, rather than close readings of few texts
  - ▶ Requires no *interpretation* of texts
- ▶ Uses a variety of statistical techniques to extract information from the document-feature matrix

## Key feature of quantitative text analysis (cont.)

- ▶ Conversion of textual features into a quantitative matrix. Features can mean:
- ▶ A quantitative or statistical procedure to extract information from the quantitative matrix
- ▶ Summary and interpretation of the quantitative results

When I presented the supplementary budget to this House last April, I said we could work our way through this period of severe economic distress. Today, I can report that notwithstanding the difficulties of the past eight months, we are now on the road to economic recovery.

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t11_gormley_green	0	0	0	3	0	2	0	3	1	1	2
t04_morgan_sf	11	8	7	15	8	19	6	5	3	6	6
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t07_odonnell_fg	5	4	2	1	5	0	1	1	0	3	0
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Descriptive statistics  
on words

Scaling documents

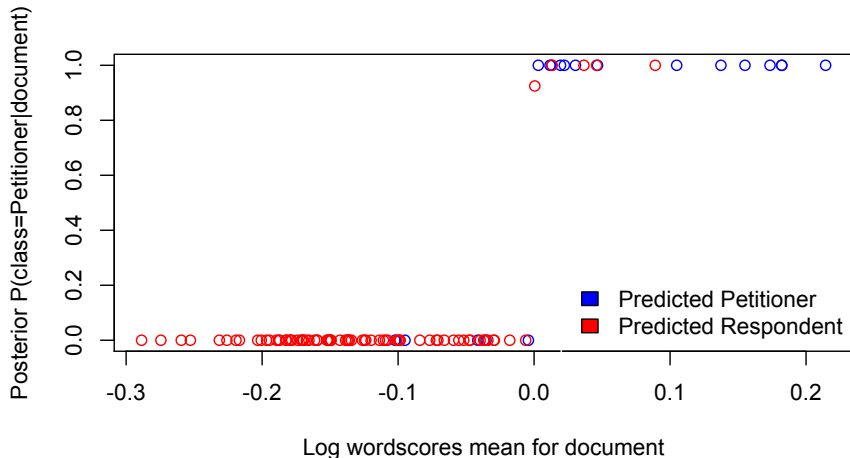
Classifying documents

Extraction of topics

Vocabulary analysis

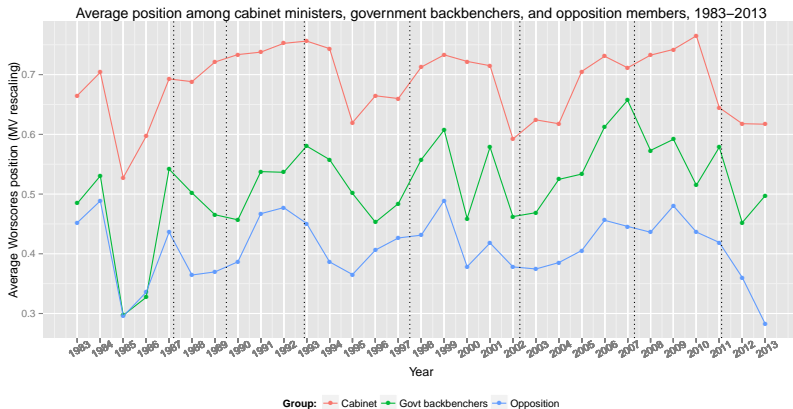
Sentiment analysis

## Example: Document classification using the “Naive Bayes” classifier



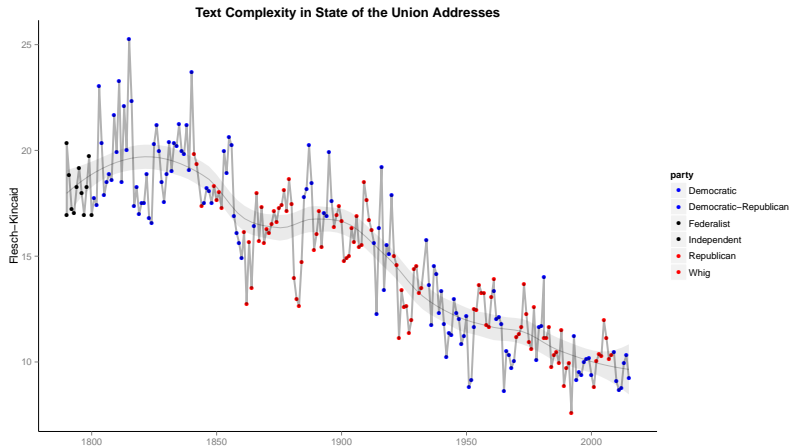


# Government v. Opposition in yearly budget debates



(from Herzog and Benoit EPSA 2013)

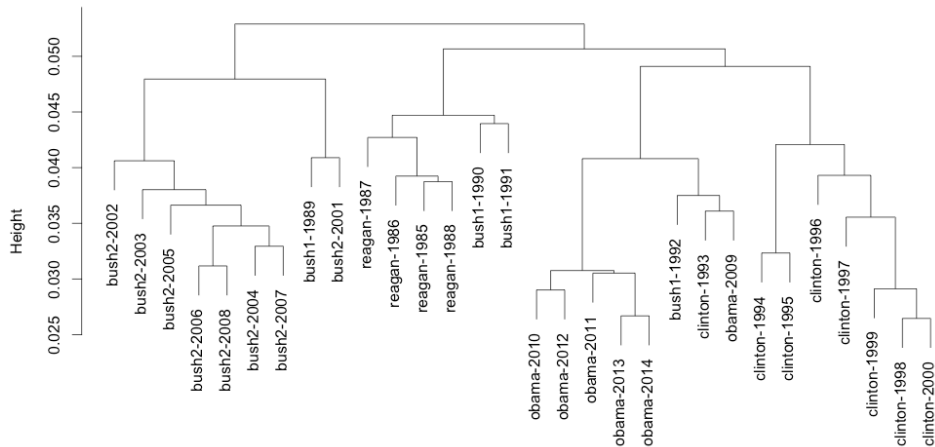
# Reading level of US State-of-the-Union addresses over time



Wordcloud of Tweets from 2014 EP campaign, by list-leading candidate

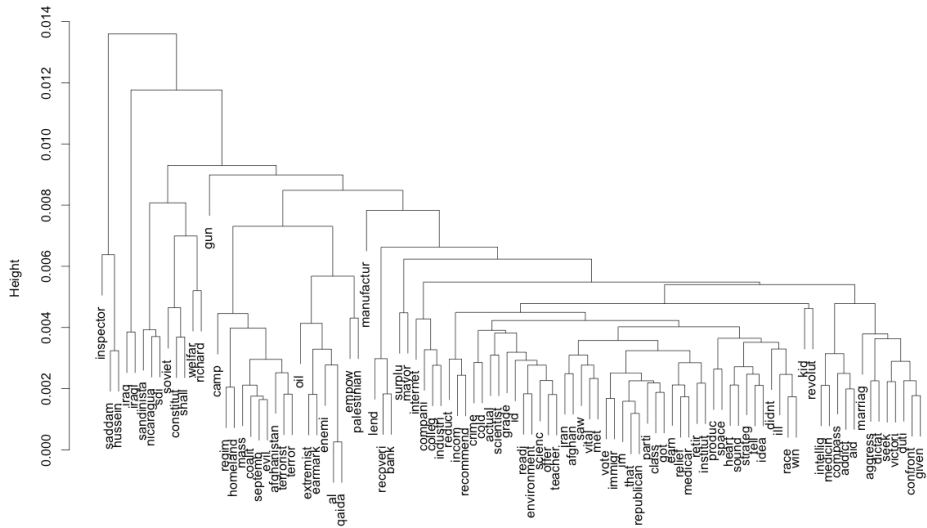


# Hierarchical clustering: Presidential State of the Union addresses

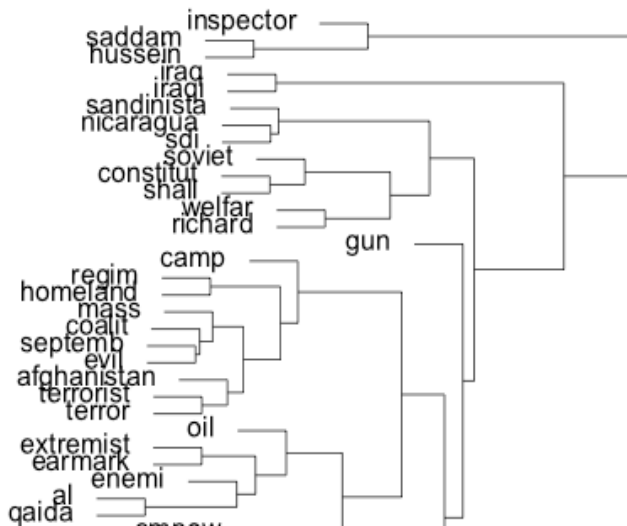


# Dendrogram: Presidential State of the Union addresses

tf-idf Frequency weighting



# Dendrogram: Presidential State of the Union addresses



# This requires assumptions

- ▶ That texts represent an observable implication of some underlying characteristic of interest (usually an attribute of the author)
- ▶ That texts can be represented through extracting their *features*
  - ▶ most common is the **bag of words** assumption
  - ▶ many other possible definitions of “features”
- ▶ A **document-feature matrix** can be analyzed using quantitative methods to produce meaningful and valid estimates of the underlying characteristic of interest

# Key feature of quantitative text analysis

1. **Selecting texts**: Defining the *corpus*
2. **Conversion** of texts into a common electronic format
3. **Defining documents**: deciding what will be the documentary unit of analysis



## Key feature of quantitative text analysis (cont.)

4. **Defining features**. These can take a variety of forms, including tokens, equivalence classes of tokens (dictionaries), selected phrases, human-coded segments (of possibly variable length), linguistic features, and more.
5. **Conversion of textual features into a quantitative matrix**
6. A **quantitative or statistical procedure** to extract information from the quantitative matrix
7. **Summary** and interpretation of the quantitative results

# Extreme forms of QTA

- ▶ Fully automated technique with minimal human intervention or judgment calls – only with regard to reference text selection
- ▶ Methods can “discover” topics with little human supervision
- ▶ Language-blind: can scaling anything that occurs with regular patterns (even without knowing what these mean)
- ▶ Could potentially work on texts like this:

ᐸᐸᐸ ᐸᐸᐸᐸᐸᐸ ᐸᐸᐸ ᐸᐸᐸᐸᐸᐸᐸᐸᐸ ᐸᐸᐸ  
ᐸᐸᐸᐸᐸᐸᐸᐸᐸ ᐸᐸᐸ ᐸᐸᐸ ᐸᐸᐸᐸᐸᐸ ᐸᐸᐸᐸ  
ᐸᐸᐸᐸᐸᐸᐸᐸ ᐸᐸᐸᐸᐸᐸᐸᐸᐸ

(See <http://www.kli.org>)

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Descriptive statistics  
on words

Scaling documents

Classifying documents

Extraction of topics

Vocabulary analysis

Sentiment analysis

# Some key basic concepts

(text) **corpus** a large and structured set of texts for analysis

**types** for our purposes, a unique word

**tokens** any word – so token count is total words

▶ **hapax legomena** (or just *hapax*) are types that occur just once

**stems** words with suffixes removed

**lemmas** canonical word form (the base form of a word that has the same meaning even when different suffixes (or prefixes) are attached)

**keys** such as dictionary entries, where the user defines a set of equivalence classes that group different word types

## Some more key basic concepts

- “key” words Words selected because of special attributes, meanings, or rates of occurrence
- stop words Words that are designated for exclusion from any analysis of a text
- readability provides estimates of the readability of a text based on word length, syllable length, etc.
- complexity A word is considered “complex” if it contains three syllables or more
- diversity (lexical diversity) A measure of how many types occur per fixed word rate (a normalized vocabulary measure)

## **Documents and Features**

# Strategies for selecting units of textual analysis

- ▶ Words
- ▶  $n$ -word sequences
- ▶ pages
- ▶ paragraphs
- ▶ Themes
- ▶ Natural units (a speech, a poem, a manifesto)
- ▶ Key: depends on the research design

# Defining Features

- ▶ words
- ▶ word stems or lemmas: this is a form of defining *equivalence classes* for word features
- ▶ word segments, especially for languages using compound words, such as German, e.g.

*Rindfleischetikettierungsüberwachungsaufgabenübertragungsgesetz*

(the law concerning the delegation of duties for the supervision of cattle marking and the labelling of beef)

*Saunauntensitzer*



## Defining Features (cont.)

- ▶ “word” sequences, especially when inter-word delimiters (usually white space) are not commonly used, as in Chinese

莎拉波娃现在居住在美国东南部的佛罗里达。今年4月9日，莎拉波娃在美国第一大城市纽约度过了18岁生日。生日派对上，莎拉波娃露出了甜美的微笑。

- ▶ linguistic features, such as parts of speech
- ▶ (if qualitative coding is used) coded or annotated text segments
- ▶ linguistic features: parts of speech

# Parts of speech

- ▶ the Penn “Treebank” is the standard scheme for tagging POS

Number	Tag	Description
1.	CC	Coordinating conjunction
2.	CD	Cardinal number
3.	DT	Determiner
4.	EX	Existential <i>there</i>
5.	FW	Foreign word
6.	IN	Preposition or subordinating conjunction
7.	JJ	Adjective
8.	JJR	Adjective, comparative
9.	JJS	Adjective, superlative
10.	LS	List item marker
11.	MD	Modal
12.	NN	Noun, singular or mass
13.	NNS	Noun, plural
14.	NNP	Proper noun, singular
15.	NNPS	Proper noun, plural
16.	PDT	Predeterminer
17.	POS	Possessive ending
18.	PRP	Personal pronoun
19.	PRP\$	Possessive pronoun
20.	RB	Adverb

21.	RBR	Adverb, comparative
22.	RBS	Adverb, superlative
23.	RP	Particle
24.	SYM	Symbol
25.	TO	<i>to</i>
26.	UH	Interjection
27.	VB	Verb, base form
28.	VBD	Verb, past tense
29.	VBG	Verb, gerund or present participle
30.	VBN	Verb, past participle
31.	VBP	Verb, non-3rd person singular present
32.	VBZ	Verb, 3rd person singular present
33.	WDT	Wh-determiner
34.	WP	Wh-pronoun
35.	WP\$	Possessive wh-pronoun
36.	WRB	Wh-adverb

## Parts of speech (cont.)

- ▶ several open-source projects make it possible to tag POS in text, namely Apache's OpenNLP (and R package openNLP wrapper)

```
> s
Pierre Vinken, 61 years old, will join the board as a nonexecutive director Nov. 29.
Mr. Vinken is chairman of Elsevier N.V., the Dutch publishing group.
> sprintf("%s/%s", s[a3w], tags)
[1] "Pierre/NNP"      "Vinken/NNP"      ",/,,"            "61/CD"
[5] "years/NNS"       "old/JJ"          ",/,,"            "will/MD"
[9] "join/VB"         "the/DT"          "board/NN"        "as/IN"
[13] "a/DT"            "nonexecutive/JJ" "director/NN"      "Nov./NNP"
[17] "29/CD"           "../."            "Mr./NNP"         "Vinken/NNP"
[21] "is/VBZ"          "chairman/NN"     "of/IN"            "Elsevier/NNP"
[25] "N.V./NNP"        ",/,,"            "the/DT"           "Dutch/JJ"
[29] "publishing/NN"   "group/NN"        "../."            "
```

# Strategies for feature selection

- ▶ **document frequency** How many documents in which a term appears
- ▶ **term frequency** How many times does the term appear in the corpus
- ▶ **deliberate disregard** Use of “stop words”: words excluded because they represent linguistic connectors of no substantive content
- ▶ **purposive selection** Use of a *dictionary* of words or phrases
- ▶ **declared equivalency classes** Non-exclusive synonyms, what I call a *thesaurus* (lots more on these on Day 4)

# Common English stop words

a, able, about, across, after, all, almost, also, am, among, an, and, any, are, as, at, be, because, been, but, by, can, cannot, could, dear, did, do, does, either, else, ever, every, for, from, get, got, had, has, have, he, her, hers, him, his, how, however, I, if, in, into, is, it, its, just, least, let, like, likely, may, me, might, most, must, my, neither, no, nor, not, of, off, often, on, only, or, other, our, own, rather, said, say, says, she, should, since, so, some, than, that, the, their, them, then, there, these, they, this, tis, to, too, twas, us, wants, was, we, were, what, when, where, which, while, who, whom, why, will, with, would, yet, you, your

- But no list should be considered universal

# A more comprehensive list of stop words

aaŽs, able, about, above, according, accordingly, across, actually, after, afterwards, again, against, ainŽt, all, allow, allows, almost, alone, along, already, also, although, always, am, among, amongst, an, and, another, any, anybody, anyhow, anyone, anything, anyway, anyways, anywhere, apart, appear, appreciate, appropriate, are, arenŽt, around, as, aside, ask, asking, associated, at, available, away, awfully, be, became, because, become, becomes, becoming, been, before, beforehand, behind, being, believe, below, beside, besides, best, better, between, beyond, both, brief, but, by, cŽmon, cŽs, came, can, canŽt, cannot, cant, cause, causes, certain, certainly, changes, clearly, co, com, come, comes, concerning, consequently, consider, considering, contain, containing, contains, corresponding, could, couldnŽt, course, currently, definitely, described, despite, did, didnŽt, different, do, does, doesnŽt, doing, donŽt, done, down, downwards, during, each, edu, eg, eight, either, else, elsewhere, enough, entirely, especially, et, etc, even, ever, every, everybody, everyone, everything, everywhere, ex, exactly, example, except, far, few, fifth, first, five, followed, following, follows, for, former, formerly, forth, four, from, further, furthermore, get, gets, getting, given, gives, go, goes, going, gone, got, gotten, greetings, had, hadnŽt, happens, hardly, has, hasnŽt, have, havenŽt, having, he, heŽs, hello, help, hence, her, here, hereŽs, hereafter, hereby, herein, hereupon, hers, herself, hi, him, himself, his, hither, hopefully, how, howbeit, however, iŽd, iŽll, iŽm, iŽve, ie, if, ignored, immediate, in, inasmuch, inc, indeed, indicate, indicated, indicates, inner, insofar, instead, into, inward, is, isnŽt, it, itŽd, itŽll, itŽs, its, itself, just, keep, keeps, kept, know, knows, known, last, lately, later, latter, latterly, least, less, lest, let, letŽs, like, liked, likely, little, look, looking, looks, ltd, mainly, many, may, maybe, me, mean, meanwhile, merely, might, more, moreover, most, mostly, much, must, my, myself, name, namely, nd, near, nearly, necessary, need, needs, neither, never, nevertheless, new, next, nine, no, nobody, non, none, noone, nor, normally, not, nothing, novel, now, nowhere, obviously, of, off, often, oh, ok, okay, old, on, once, one, ones, only, onto, or, other, others, otherwise, ought, our, ours, ourselves, out, outside, over, overall, own, particular, particularly, per, perhaps, placed, please, plus, possible, presumably, probably, provides, que, quite, qv, rather, rd, re, really, reasonably, regarding, regardless, regards, relatively, respectively, right, said, same, saw, say, saying, says, second, secondly, see, seeing, seem, seemed, seeming, seems, seen, self, selves, sensible, sent, serious, seriously, seven, several, shall, she, should, shouldnŽt, since, six, so, some, somebody, somehow, someone, something, sometime, sometimes, somewhat, somewhere, soon, sorry, specified, specify, specifying, still, sub, such, sup, sure, tŽs, take, taken, tell, tends, th, than, thank, thanks, thanx, that, thatŽs, thats, the, their, theirs, them, themselves, then, thence, there, thereŽs, thereafter, thereby, therefore, therein, theres,

# Stemming words

**Lemmatization** refers to the algorithmic process of converting words to their lemma forms.

**stemming** the process for reducing inflected (or sometimes derived) words to their stem, base or root form. Different from *lemmatization* in that stemmers operate on single words without knowledge of the context.

**both** convert the morphological variants into stem or root terms

**example:** **produc** from  
production, producer, produce, produces,  
produced

## **Descriptive text analysis**



# Exploring Texts: Key Words in Context

**KWIC** *Key words in context* Refers to the most common format for concordance lines. A KWIC index is formed by sorting and aligning the words within an article title to allow each word (except the stop words) in titles to be searchable alphabetically in the index.

## **lime (14)**

79[C.10] 4 /Which was builded of **lime** and sand;/Until they came to  
247A.6 4 /That was well biggit with **lime** and stane.  
303A.1 2 bower./Well built wi **lime** and stane./And Willie came  
247A.9 2 /That was well biggit wi **lime** and stane./Nor has he stoln  
305A.2 1 a castell biggit with **lime** and stane./O gin it stands not  
305A.71 2 is my awin./I biggit it wi **lime** and stane;/The Tinnies and  
79[C.10] 6 /Which was builded with **lime** and stone.  
305A.30 1 a prittie castell of **lime** and stone./O gif it stands not  
108.15 2 /Which was made both of **lime** and stone./Shee tooke him by  
175A.33 2 castle then./Was made of **lime** and stone;/The vttermost  
178[H.2] 2 near by./Well built with **lime** and stone;/There is a lady  
178F.18 2 built with stone and **lime**!/But far mair pittie on Lady  
178G.35 2 was biggit wi stane and **lime**!/But far mair pity o Lady  
2D.16 1 big a cart o stane and **lime**./Gar Robin Redbreast trail it

# Another KWIC Example (Seale et al (2006))

Table 3

Example of Keyword in Context (KWIC) and associated word clusters display

---

*Extracts from Keyword in Context (KWIC) list for the word 'scan'*

An MRI **scan** then indicated it had spread slightly

Fortunately, the MRI **scan** didn't show any involvement of the lymph nodes

3 very worrying weeks later, a bone **scan** also showed up clear.

The bone **scan** is to check whether or not the cancer has spread to the bones.

The bone **scan** is done using a type of X-ray machine.

The results were terrific, CT **scan** and pelvic X-ray looked good

Your next step appears to be to await the result of the **scan** and I wish you well there.

I should go and have an MRI **scan** and a bone **scan**

*Three-word clusters most frequently associated with keyword 'scan'*

<i>N</i>	<i>Cluster</i>	<i>Freq</i>
1	A bone scan	28
2	Bone scan and	25
3	An MRI scan	18
4	My bone scan	15
5	The MRI scan	15
6	The bone scan	14
7	MRI scan and	12
8	And Mri scan	9
9	Scan and MRI	9

---

# Another KWIC Example: Irish Budget Speeches

WordStat 6.1.7 - IRISH BUDGETS.DBF

Dictionaries Options Frequencies Phrase finder Crosstab **Keyword-In-Context**

List: User defined    Sort by: Case number    Word: CHRISTMAS    Context delimiter: None

CASINO	KEYWORD
2 rally disappointed by what we have seen today. Instead of the Minister taking the radical	Christmas in the hope of something better in the new year? The Minister has failed those employers.
3 sents, people on disability and even blind people. The Minister has some nerve quoting Ted	Christmas hit single. Fianna Fáil's hit single for Christmas will be, "I saw NAMA killing Santa Claus". Pa
3 Minister has some nerve quoting Ted Kennedy, the champion of the poor and fairness in A	Christmas will be, "I saw NAMA killing Santa Claus". Parents should know that child benefit is being c
3 ications, how much worse is it for the early school leaver and young unemployed person?	Christmas because they must take the decision to leave, as people all over rural Ireland and every toy
3 i reminding everyone that Fianna Fáil was the party that looked after child benefit. It wou	Christmas .With a possible election next year, one never knows when a club might come in handy to
3 is. The Minister should ask Tiger Woods about it. I have read scores of articles by people	Christmas ? Is the Society of St. Vincent de Paul out of touch? Are they saying social welfare in Ireland
3 elusive but most vital ingredient of economic policy. One cannot bottle it or buy it and there	Christmas time people were laden down with shopping bags. If one walks over to Grafton Street one
4 al effect on the economy and society. Social welfare payments are always returned to the	Christmas bonus, a double payment which affected 1.3 million people, is money that would have beer
4 hey are spent on rent, mortgages, food, utilities and other essentials. Cutting welfare expe	Christmas food. The Government's Scrooge measures will come back to haunt it when it counts its V.
4 onsiderable difference to the pattry few millions of euro offered to job creation and retento	Christmas in debt, in poverty and with the prospect of the very small payments made to them by the S
4 embers of the Government spoken to people in rural Ireland about how even as we speak	Christmas bonus. Of course, that is not too complicated and it can easily be accomplished. The Gover
4 nents will have a detrimental effect on the economy and society. Social welfare payments	Christmas . The loss of the Christmas bonus, a double payment which affected 1.3 million people, is r
6 is is not happening. Day after day, Deputies, including those opposite, are receiving eviden	Christmas .I do not know whether Deputy Perry heard a woman from Sligo speaking on radio this mo
7 but the Government did not see fit to remove it. Such countries as Holland realised the ero	Christmas period. We suggested that the lower rate of VAT should be reduced. That would not be as
7 o poverty. Every family is today paying the price for 12 years of incompetent, reckless, dis	Christmas payment. A couple on invalidity pension suffers a cut of €1,100. Carer's benefit is cut by €
8 al parties for an adjustment of €4 billion. However, choices had to be made. What were th	Christmas payment is gone. Earnest lectures on price statistics will not feed a hungry child or clothe t
8 have been put onto the dole queue. Fianna Fáil has created one of the longest and deepest	Christmas . we will witness the scenes of heartbreak and loss at airports and ferry ports as the cre
13 fiscal crisis, as Deputy Gilmore pointed out. The policies within this budget will get us throu	Christmas recess work will be done in Leinster House to replace gas boilers with biomass boilers. Th
14 it is over and that this is "the last big push". I was expecting him to say it will all be over by	Christmas . If it is the last big push, we know who he's sending over the top — the low paid workers

I hear sports shops are doing a roaring trade in single golf clubs this **Christmas**. With a possible election next year, one never knows when a club might come in handy to deal with men who break their promises. The Minister should ask Tiger Woods about it.

I have read scores of articles by people who argue that child benefit payments are of little importance, including journalists and academics who argue it would make no difference if the payment were restricted. Most of these articles were written by men, none of whom could state absolutely that he spoke for his wife or partner. I have yet to meet a mother of young or teenage children who says casually that child benefit has no importance to her. Perhaps I do not mix in circles where this benefit is a trifle. Certainly, I do not represent a constituency that places no value on the advantages of universal child benefit.

Almost every day I hear the voice of Marian Finucane on radio advertisements for the Simon Community, as I am sure everyone here does. She tells us that the current crisis has brought community services to breaking point. I hear the same message from Professor John Monaghan of the Society of St. Vincent de Paul. Are these societies lying? Is the Simon Community faking its message this **Christmas**? Is the Society of St. Vincent de Paul out of touch? Are they saying social welfare in Ireland is so generous that it can be cut? I have

14 cases    Number of items: 19

# Irish Budget Speeches KIWC in quanteda

```
R Console

> data(iebudgets)
> iebudgets2010 <- subset(iebudgets, year==2010)
> kwic(iebudgets2010, "christmas", regex=TRUE)

[2010_BUDGET_02_Richard_Bruton_FG.txt, 628]      preword      word      postword
[2010_BUDGET_03_Joan_Burton_LAB.txt, 371]
[2010_BUDGET_03_Joan_Burton_LAB.txt, 379]
[2010_BUDGET_03_Joan_Burton_LAB.txt, 922]
[2010_BUDGET_03_Joan_Burton_LAB.txt, 1518]
[2010_BUDGET_03_Joan_Burton_LAB.txt, 1726]
[2010_BUDGET_03_Joan_Burton_LAB.txt, 3159]
[2010_BUDGET_04_Arthur_Morgan_SF.txt, 346]
[2010_BUDGET_04_Arthur_Morgan_SF.txt, 3239]
[2010_BUDGET_04_Arthur_Morgan_SF.txt, 3244]
[2010_BUDGET_04_Arthur_Morgan_SF.txt, 3272]
[2010_BUDGET_04_Arthur_Morgan_SF.txt, 5899]
[2010_BUDGET_06_Enda_Kenny_FG.txt, 2629]
[2010_BUDGET_07_Kieran_ODonnell_FG.txt, 1365]
[2010_BUDGET_08_Eamon_Gilmore_LAB.txt, 550]
[2010_BUDGET_08_Eamon_Gilmore_LAB.txt, 638]
[2010_BUDGET_08_Eamon_Gilmore_LAB.txt, 998]
[2010_BUDGET_13_Ciaran_Cuffe_Green.txt, 911]
[2010_BUDGET_14_Caoimhghin_O'Caolain_SF.txt, 148]

      and to see out this Christmas in the hope of something
      to suggest titles for a Christmas hit single. Fianna Fáil's hit
      Fianna Fáil's hit single for Christmas will be, "I saw NAMA
      women will say goodbye after Christmas because they must take the
      in single golf clubs this Christmas. With a possible election next
      Community faking its message this Christmas? Is the Society of St.
      bags. In previous years at Christmas time people were laden down
      €204 per week or the Christmas bonus. Of course, that is
      to social welfare payments this Christmas. The loss of the Christmas
      Christmas. The loss of the Christmas bonus, a double payment which
      streets on Santa presents and Christmas food. The Government's Scrooge measures
      their jobs, who face this Christmas in debt, in poverty and
      [2010_BUDGET_06_Enda_Kenny_FG.txt, 2629] to implement the reduction before Christmas. I do not know whether
      from the change in the Christmas period. We suggested that the
      cut of €641, including the Christmas payment. A couple on invalidity
      are on social welfare, the Christmas payment is gone. Earnest lectures
      of emigration. Once again this Christmas, we will witness the scenes
      noted recently that over the Christmas recess work will be done
      will all be over by Christmas. If it is the last
```

# Basic descriptive summaries of text

**Readability statistics** Use a combination of syllables and sentence length to indicate “readability” in terms of complexity

**Vocabulary diversity** (At its simplest) involves measuring a *type-to-token ratio* (TTR) where unique words are types and the total words are tokens

**Word (relative) frequency**

**Theme (relative) frequency**

**Length** in characters, words, lines, sentences, paragraphs, pages, sections, chapters, etc.

## Simple descriptive table about texts: Describe your data!

Speaker	Party	Tokens	Types
Brian Cowen	FF	5,842	1,466
Brian Lenihan	FF	7,737	1,644
Ciaran Cuffe	Green	1,141	421
John Gormley (Edited)	Green	919	361
John Gormley (Full)	Green	2,998	868
Eamon Ryan	Green	1,513	481
Richard Bruton	FG	4,043	947
Enda Kenny	FG	3,863	1,055
Kieran O'Donnell	FG	2,054	609
Joan Burton	LAB	5,728	1,471
Eamon Gilmore	LAB	3,780	1,082
Michael Higgins	LAB	1,139	437
Ruairi Quinn	LAB	1,182	413
Arthur Morgan	SF	6,448	1,452
Caoimhghin O'Caolain	SF	3,629	1,035
All Texts		49,019	4,840
<i>Min</i>		919	361
<i>Max</i>		7,737	1,644
<i>Median</i>		3,704	991
<i>Hapaxes with Gormley Edited</i>		67	
<i>Hapaxes with Gormley Full Speech</i>		69	

# Lexical Diversity

- ▶ Basic measure is the **TTR**: Type-to-Token ratio
- ▶ Problem: This is very sensitive to overall document length, as shorter texts may exhibit fewer word repetitions
- ▶ Special problem: length may relate to the introduction of additional subjects, which will also increase richness

# Vocabulary diversity and corpus length

- In natural language text, the rate at which new types appear is very high at first, but diminishes with added tokens

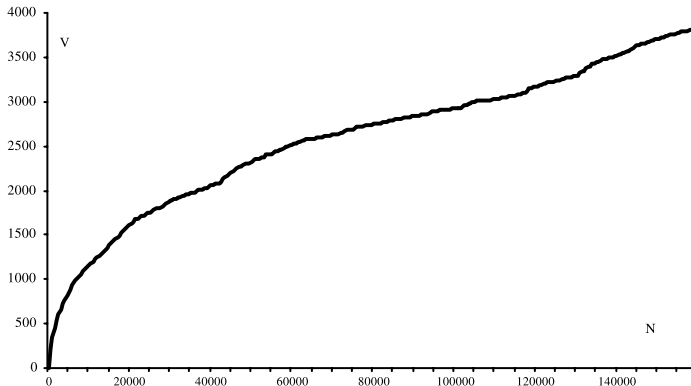


Fig. 1. Chart of vocabulary growth in the tragedies of Racine (chronological order, 500 token intervals).



# Vocabulary Diversity Example

- ▶ Variations use automated segmentation – here approximately 500 words in a corpus of serialized, concatenated weekly addresses by de Gaulle (from Labbé et. al. 2004)
- ▶ While most were written, during the period of December 1965 these were more spontaneous press conferences

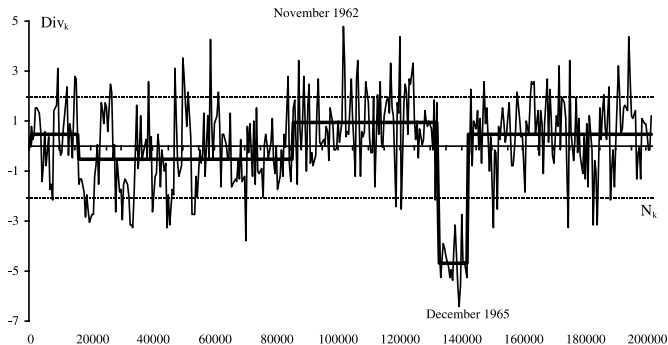


Fig. 8. Evolution of vocabulary diversity in General de Gaulle's broadcast speeches (June 1958–April 1969).

## **Content analysis**

# Hand-coding: “Classic” content analysis

- ▶ Key feature: use of “human” coders to implement a pre-defined coding scheme, by reading and coding texts
- ▶ Human decision-making is the central feature of coding decisions, not a computer or other mechanized tool
- ▶ Differs from thematic analysis in that the coding scheme is *fixed*
- ▶ Alternative 1: (somewhat more automated) is a dictionary approach
- ▶ Alternative 2: (entirely “automated”) is inductive scaling of texts from the quantitative matrix

# Hand-coding': “Classic” content analysis

- ▶ Validity is usually the objective, rather than reliability
- ▶ Another motivating factor could be ease of use, or the difficulty of implementing an automated procedure
- ▶ May be *computer-assisted*, especially for **unitization**
- ▶ Many common “CATA” or “CACA” tools exist – e.g. QDAMiner

# Components of classical content analysis designs

**Unitizing** The systematic distinguishing of segments of text that are of interest to the analysis.

**Sampling** Choice (and justification of the choice) of text units to sample, from population of possible text units.

**Coding** Classifying each coded unit of text from the sample according to the pre-defined category scheme.

**Summarizing** Reducing the coded data to summary quantities of interest.

**Inference and reporting** The final steps wherein the analyzed results are used to generalize about social world, and communicating these results to others.

## **Dictionary analysis**

# Rationale for dictionaries

- ▶ Rather than count words that occur, pre-define words associated with specific meanings
- ▶ Two components:
  - key** the label for the equivalence class for the concept or canonical term
  - values** (multiple) terms or patterns that are declared equivalent occurrences of the key class
- ▶ Frequently involves lemmatization: transformation of all inflected word forms to their “dictionary look-up form” — more powerful than stemming

# Bridging qualitative and quantitative text analysis

- ▶ A hybrid procedure between qualitative and quantitative classification the fully automated end of the text analysis spectrum
- ▶ “Qualitative” since it involves identification of the concepts and associated keys/categories, and the textual features associated with each key/category
- ▶ Dictionary construction involves a lot of contextual interpretation and qualitative judgment
- ▶ Perfect reliability because there is no human decision making as part of the text analysis procedure



# Linguistic Inquiry and Word Count

- ▶ Created by Pennebaker et al — see <http://www.liwc.net>
- ▶ uses a dictionary to calculate the percentage of words in the text that match each of up to 82 language dimensions
- ▶ Consists of about 4,500 words and word stems, each defining one or more word categories or subdictionaries
- ▶ For example, the word *cried* is part of five word categories: sadness, negative emotion, overall affect, verb, and past tense verb. So observing the token *cried* causes each of these five subdictionary scale scores to be incremented
- ▶ Hierarchical: so “anger” are part of an *emotion* category and a *negative emotion* subcategory
- ▶ You can **buy** it here:  
<http://www.liwc.net/descriptiontable1.php>

# Example: Terrorist speech

	Bin Ladin (1988 to 2006) N = 28	Zawahiri (2003 to 2006) N = 15	Controls N = 17	p (two- tailed)
Word Count	2511.5	1996.4	4767.5	
Big words (greater than 6 letters)	21.2a	23.6b	21.1a	.05
Pronouns	9.15ab	9.83b	8.16a	.09
I (e.g. I, me, my)	0.61	0.90	0.83	
We (e.g. we, our, us)	1.94	1.79	1.95	
You (e.g. you, your, yours)	1.73	1.69	0.87	
He/she (e.g. he, hers, they)	1.42	1.42	1.37	
They (e.g., they, them)	2.17a	2.29a	1.43b	.03
Prepositions	14.8	14.7	15.0	
Articles (e.g. a, an, the)	9.07	8.53	9.19	
Exclusive Words (but, exclude)	2.72	2.62	3.17	
Affect	5.13a	5.12a	3.91b	.01
Positive emotion (happy, joy, love)	2.57a	2.83a	2.03b	.01
Negative emotion (awful, cry, hate)	2.52a	2.28ab	1.87b	.03
Anger words (hate, kill)	1.49a	1.32a	0.89b	.01
Cognitive Mechanisms	4.43	4.56	4.86	
Time (clock, hour)	2.40b	1.89a	2.69b	.01
Past tense verbs	2.21a	1.63a	2.94b	.01
Social Processes	11.4a	10.7ab	9.29b	.04
Humans (e.g. child, people, selves)	0.95ab	0.52a	1.12b	.05
Family (mother, father)	0.46ab	0.52a	0.25b	.08
Content				
Death (e.g. dead, killing, murder)	0.55	0.47	0.64	
Achievement	0.94	0.89	0.81	
Money (e.g. buy, economy, wealth)	0.34	0.38	0.58	
Religion (e.g. faith, Jew, sacred)	2.41	1.84	1.89	

Note. Numbers are mean percentages of total words per text file. Statistical tests are between Bin Ladin, Zawahiri, and Controls. Documents whose source indicates "Both" (n=3) or "Unknown" (n=2) were excluded due to their small sample sizes.

# Advantage: Multi-lingual

APPENDIX B  
DICTIONARY OF THE COMPUTER-BASED CONTENT ANALYSIS

	NL	UK	GE	IT
<b>Core</b>	elit* consensus* ondemocratisch* ondemokratisch* referend* corrupt* propagand* politici* *bedrog* *bedrieg*  *verraa* *verrad* schaam*  schand* waarheid* oneerlijk*	elit* consensus* undemocratic*  referend* corrupt* propagand* politici* *deceit* *deceiv*  *betray*  shame*  scandal* truth* dishonest*	elit* konsens* undemokratisch*  referend* korrupt* propagand* politiker* täusch* betrüg* betrug* *verrat*  scham* schäm* skandal* wahrheit* unfair* unehrlich* establishm* *herrschr*  lüge*	elit* consens* antidemocratic*  referend* corrot* propagand* politici* ingann*  tradi*  vergogn*  scandal* verità* disonest*  partitocrazia  menzogn* mentir*
<b>Context</b>	establishm* heersend* capitul* kapitul* kaste* leugen* lieg*	establishm* ruling*		

(from Rooduijn and Pauwels 2011)

## Disdvantage: Highly specific to context

- ▶ Example: Loughran and McDonald used the Harvard-IV-4 TagNeg (H4N) file to classify sentiment for a corpus of 50,115 firm-year 10-K filings from 1994–2008
- ▶ found that almost three-fourths of the “negative” words of H4N were typically not negative in a financial context  
e.g. *mine* or *cancer*, or *tax*, *cost*, *capital*, *board*, *liability*, *foreign*, and *vice*
- ▶ Problem: **polysemes** – words that have multiple meanings
- ▶ Another problem: dictionary lacked important negative financial words, such as *felony*, *litigation*, *restated*, *misstatement*, and *unanticipated*